

ACCESSION #: 9811190136

NON-PUBLIC?: N

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Sequoyah Nuclear Plant (SQN) Unit 2 PAGE: 1 OF 9

DOCKET NUMBER: 05000328

TITLE: Turbine and Reactor Trips Resulting From A Failure of the
'B' Phase Main Transformer Sudden Pressure Relay.

EVENT DATE: 10/16/1998 LER #: 1998-002-00 REPORT DATE: 11/10/1998

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION:

50.73(a)(2)(i) & 50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

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COMPONENT FAILURE DESCRIPTION:

CAUSE: X SYSTEM: FK COMPONENT: RLY MANUFACTURER: Q011

REPORTABLE TO NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On October 15, 1998, at 0501 Eastern Daylight time (EDT), a turbine trip occurred followed by a reactor trip. The event resulted from a generator lockout caused by a failure of a sudden pressure relay on the 'B' phase main transformer. Operators responded to the trip as prescribed by procedures and stabilized the reactor in a safe condition. On October 15, 1998, at 2309 EDT, during restart of the unit, Operators entered Limiting Condition for Operation (LCO) 3.0.3 when 4 rod position indicators in Control Bank C were more than 12 steps out from their respective demand position indicators. Operators withdrew

the control rods correcting the indication problem. TVA believes that the sudden pressure relay failed because one of the control bellows had cracked and was leaking relay working fluid (Silicon). TVA considers that the crack in the control bellows was the result of vibration induced fatigue. The trip function of the sudden pressure relays was disabled from the main transformers and the unit station service transformers. A modification is being evaluated to physically isolate the relays from the vibration of the transformers and adding a two out of two logic for actuation of the sudden pressure relay trip function.

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I. PLANT CONDITIONS

Unit 2 was in power operation at approximately 100 percent.

II. DESCRIPTION OF EVENT

A. Event

On October 16, 1998, at 0501 Eastern Daylight time (EDT), a turbine trip occurred followed by a reactor trip. The event resulted from initiation of a generator lockout (generator electrical trip) with a subsequent turbine trip initiated by failure of a sudden pressure relay [EIIS Code RLY] on the 'B' phase main transformer [EIIS Code FK]. A review of the condition determined that the transformer did not experience a fault. The reactor protection systems, including feedwater isolation and auxiliary feedwater start, responded as expected to the trip; no anomalies occurred.

During restart of the unit, on October 15, 1998, at 2309 EDT, with Unit 2 in Mode 2, Operations entered Technical Specification (TS) Limiting Condition for Operation (LCO) 3.0.3. The rod position indicators (RPIs) for Control Bank C [EIIS Code AA] Rods

H2, F6, K10, and B8 were more than 12 steps out from their respective demand position indicators (step counters).

B. Inoperable Structures, Components, or Systems that Contributed to the Event

None.

C. Dates and Approximate Times of Major Occurrences

October 15, 1998, A generator lockout occurred, with a at 0501 EDT. subsequent turbine trip followed by a reactor trip. The 'B' phase main transformer sudden pressure relay initiated the trip signal. The main

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control room operators stabilized the reactor in Mode 3 (hot standby).

October 15, 1998, Operations entered LCO 3.0.3 when the at 2309 EDT. RPIs for 4 Control Bank C rods were more than 12 steps out from their respective demand position indicators.

October 15, 1998, Operations withdrew control rods at 2312 EDT. placing the Control Bank C RPIs within the required 12 steps. Operations exited LCO 3.0.3.

D. Other Systems or Secondary Functions Affected

None.

E. Method of Discovery

The turbine and reactor trips were annunciated on the main control room panels.

Operators discovered the mismatch between the demand position indicator and the rod position indication system (RPIS) for the Control Bank C indicators while monitoring the control panels during start-up activities.

F. Operator Actions

Control room operators responded to the turbine and reactor trips as prescribed by emergency procedures. They promptly diagnosed the condition, and took necessary actions to stabilize and maintain the unit in a safe condition.

During startup, briefings were held prior to control rod withdrawal. The briefings included a discussion of the potential mismatch between the demand position indicator and the RPIs, and the TS actions associated with the RPIs. The necessity for log entries regarding the possible situation, actively observing for the condition, and

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vocalizing the status of rod position on withdrawal were discussed. operations established plans to withdraw rods, as appropriate, to obtain a match between the indicators. Before

starting rod withdrawal, Operations initiated contingency plans to ensure that the RPIS provided an accurate indication if problems were encountered.

Following discovery of the mismatch between the demand position indicator and the RPIS, the operators entered LCO 3.0.3. The operator withdrew the control rods to move the rods outside the mismatch region correcting the indication problem.

G. Safety System Responses

The plant responded to the turbine and reactor trips as designed.

No safety system response was required for the mismatch between the demand position indicator and the RPIS.

III. CAUSE OF THE EVENT

A. Immediate Cause

The immediate cause of the unit trip was the initiation of a generator lockout (generator electrical trip) signal by the 'B' phase main transformer protection circuit from a failed sudden pressure relay.

The immediate cause for the mismatch between the demand position indicator and the RPIS was incorrect position indication on the RPIS.

B. Root Cause

The root cause of the unit trip was the failure of a sudden pressure relay located on the 'B' phase main transformer.

Examination of the device found oil in the relay housing. TVA determined that the fluid was silicon oil from the

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internals of the relay. Troubleshooting found that the control bellows with the orifice had developed a leak resulting in a mismatch of the control bellows and actuation of the switch. TVA considers the leak to be the result of vibration induced fatigue.

The root cause for the mismatch between the demand position indicator and the RPIS is that the response of the RPI is nonlinear. The RPI coil stack (Linear Variable Differential Transformer), output is nonlinear causing the mismatch phenomenon. The system is also susceptible to temperature changes, that is, a hot control rod jack shaft being withdrawn.

The RPI indicates lower than actual rod position below 20 steps and above 215 steps. The system indicates higher than actual rod position between 20 and 215 steps. The mismatch is most prevalent between 120 and 180 steps. This situation, in conjunction with the calibration tolerance of the RPI instruments, can result in exceeding the TS requirement of plus or minus 12 steps. Control Bank C was at 144 steps on the demand position indicator when the mismatch occurred.

C. Contributing Factors

None.

IV. ANALYSIS OF THE EVENT

The plant safety systems functioned properly during and after the unit trip. Accordingly, the event did not adversely affect the health and safety of plant personnel or the general public.

SQN has two separate systems to provide control rod position indication, the RPIS and the demand position indication system (step counter). Each system serves as a backup for the other. In this event, the demand position indication system provided the correct indication. The actual position of the rods was indicated by the demand position indication system and was not in error. Therefore, there were no adverse consequences to the health and safety of plant personnel or the general public as a

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result of this condition.

V. CORRECTIVE ACTIONS

A. Immediate Corrective Actions

Control room operators responded to the turbine and reactor trips as prescribed by emergency procedures. Operators promptly diagnosed the condition and took necessary actions to stabilize and maintain the unit in a safe condition.

In response to the mismatch between the demand position indicator and the RPIS, operators entered TS LCO 3.0.3. The operators withdrew the rods correcting the indication problem.

B. Corrective Actions to Prevent Recurrence

The sudden pressure relay trip function located on the main transformers and the unit station service transformers on both units was disabled. A modification is being evaluated to physically isolate the relays from the vibration of the transformers and adding a two out of two logic for actuation of the sudden pressure relay trip function. 1_ /

TVA is evaluating options regarding changes to the TS. One of the options is to add actions to the applicable specification to address the condition when the mismatch occurs. The other option is to increase the limit from 12 steps to 18 steps. 1_ /

1_ / TVA does not consider this corrective action a regulatory commitment.

TVA's Corrective Action Program will track completion of the action.

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VI. ADDITIONAL INFORMATION

A. Failed Components

The sudden pressure relay, Qualitrol Corporation Model No. 900-003-01, was examined and found to have failed (the control bellows with the orifice had developed a leak resulting in a mismatch of the control bellows and actuation of the switch).

Analysis of the failed device and previously failed devices, examination of the "as constructed" configuration, and ongoing

tests presently indicate that excessive vibration is being seen by the relay mechanism.

Figure "QUALITROL 900 SERIES "RAPID PRESSURE RISE" RELAY" omitted.

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PRINCIPLE OF OPERATION: Changes in the transformer's internal pressure deflects the Sensing Bellows and responding Control Bellows that are part of a sealed system filled with Silicon Fluid. A small Control Orifice in the line of one of the Control Bellows, whose effective area is varied with temperature by a Bimetal Temperature Compensator, causes differential deflection of the two Control Bellows. The resultant "cocking" of the Actuator Linkage trips the Electrical Switch at unsafe rate of pressure rise. When the two Control Bellows again reach equilibrium, the Electrical Switch automatically resets itself.

Figure omitted

B. Previous LERs on Similar Events

A review of previous events identified four other events (50-327/86026, 90022, 95010 and 50-328/1998001) associated with the failure of the sudden pressure relay. Those failures resulted from a shorted micro-switch, shorted

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wiring terminal, a failure of the nonorificed control bellows, and a worn rocker arm pin to the degree that proper operation of the device was prevented (the device was in a constant trip

condition). The pin failure mechanism appears to be wear (fretting) resulting from vibration. Actions were in the process of being taken to reduce the vibration effects on the sudden pressure relays when this event occurred. Completion of these corrective actions would have reduced the potential for the event described by this LER.

A review of previous events associated with mismatch of RPIs identified five previous licensee event reports (LERs) (50-327/89026, 95009, 96007, 96011, and 50-328/91001). These LERs document similar events involving rod position indicators being greater than 12 steps out from their respective demand position indicators. In the 1989 to 1991 timeframe, it was concluded that the temperature of containment affected the rod position indication. Subsequently, it was determined that the cause was the result of the response of the RPI is nonlinear.

The previous corrective actions included a review of lessons learned (i.e., when practical, limit the amount of operating time in the subject region) with operators and Reactor Engineering personnel. A TS change was initiated to request that the 12-step limit be increased to 18 steps in the upper and lower portions of the range or possibly over the entire range.

C. Additional Information

None.

VII. COMMITMENTS

None.

*** END OF DOCUMENT ***
